NCCWD Pacifica Water Recycling Project
Environmental Assessment

APPENDIX A
Species Table

APPENDIX A – SPECIES TABLE

Species Name	Status	Habitat	Potential for Occurrence Onsite
Invertebrates			
San Bruno elfin butterfly (*Callophrys mossii bayensis*)	FE	Occurs in coastal, mountainous areas with grassy ground cover, mainly in the vicinity of San Bruno Mountain. Elfin colonies are located on steep, north-facing slopes within the fog belt. Larval host plant is *Sedum spathulifolium*.	None. No suitable habitat present. Host plant not detected on site.
Monarch butterfly (*Danaus plexippus*)	Considered a Special Animal by CDFG	Winter roosts sites located in wind-protected tree groves (eucalyptus, Monterey pine, cypress) with water and nectar sources nearby.	None. No suitable winter roost sites present.
Mission blue butterfly (*Plebejus icarioides missionensis*)	FE	Inhabits grasslands of the San Francisco peninsula. The mission blue butterfly uses three larval host plants: *Lupinus albifrons*, *L. formosus*, and *L. variicolor.*	Extremely low. One patch of lupines occurs on a roadcut on the east end of Gypsy Hill Road. This patch is likely too small to be used by Mission blues.
Callippe silverspot butterfly (*Speyeria callippe callippe*)	FE	Inhabits native grasslands; requires its larval food plant, *Viola pedunculata*	None. No suitable habitat present. Host plant not detected on site.
Myrtle's silverspot (*Speyeria zerene myrtleae*)	FE	Inhabits coastal dune and native prairie habitats; requires its larval food plant, *Viola adunca*	None. Host plant not detected on site. Species believed extirpated from San Mateo County.
Reptiles			
San Francisco garter snake (*Thamnophis sirtalis tetrataenia*)	FE, SE	Vicinity of freshwater marshes, ponds, and slow moving streams. Prefers dense cover and water depths of at least one foot. Upland areas near water are important.	Moderate. Species has been recorded Calera Creek, near the Project Area.
Western pond turtle (*Actinemys marmorata*)	CSC	An aquatic turtle of ponds, marshes, rivers, streams & irrigation ditches with aquatic vegetation. Require basking sites with suitable (sandy banks or grassy open fields) upland habitat for egg-laying.	Moderate. The Project Area supports suitable habitat within the creek corridor.
Amphibians			
California red-legged frog (*Rana aurora draytonii*)	FT, CSC	Lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation. Requires 11-20 weeks of permanent water for larval development.	High. The species is known to occur in Calera Creek. High quality potential habitat occurs in the Project Area.
California tiger salamander (*Ambystoma*	FT, candidate for CESA endangered,	Estivates in ground squirrel burrows; breeds in stockponds, pools of streams and vernal pools. The species is rarely	None. No estivating habitat (ground squirrel burrows) observed in

Species Name	Status	Habitat	Potential for Occurrence Onsite
californiense)	CSC	observed migrating over upland habitats.	the Project Area. The species is not known to occur in the project vicinity.
Fish			
Coho salmon-central California coast ESU (*Oncorhynchus kisutch*)	FE, SE	Spawns in freshwater streams in sand or gravel beds. Young smolts live in streams and estuaries before returning to the ocean.	None. Species has not been recorded within creeks in Project Area.
Steelhead – central California coast ESU (*Oncorhynchus mykiss irideus*)	FT	The Central California Coast Distinct Population Segment extends from the Russian River in the north to Soquel Creek in the south.	None. Species has not been recorded within creeks in Project Area.
Birds			
Swainson's hawk (*Buteo swainsoni*)	ST	Open country such as grassland, shrubland, and agricultural areas.	Very low. Species is a very rare migrant. Species has been recorded within the Project Area.
Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*)	CSC	Resident of the San Francisco bay region, in fresh and salt water marshes. Requires thick, continuous cover down to water surface for foraging; tall grasses, tule patches, willows for nesting.	Low. Limited suitable habitat within Calera Creek corridor.
Merlin (*Falco columbaris*)	Considered a Special Animal by CDFG	Seacoast, tidal estuaries, open woodlands, savannahs, edges of grasslands & deserts, farms & ranches.	Low. Species has been recorded within the Project Area, although species is uncommon.
Bank swallow (*Riparia riparia)*	ST	Nests in colonies on banks or cliffs adjacent to streams, canals or lakes.	None. No potential habitat for this species occurs in the Project Area.
Loggerhead shrike (*Lanius ludovicianus*)	CSC	Nests in dense shrubs and brush near open foraging areas such as grasslands.	Moderate. The species has been observed foraging in the Project Area.
Peregrine falcon (*Falco peregrinus anatum*)	CE, FP	Nests in cliffs and rock outcrops adjacent to forests, canyons and grasslands. Hunts other birds from the air.	Low. No nesting habitat at site. The Project Area provides foraging habitat for the species.
White-tailed kite (*Elanus leucurus*)	FP	Nests in dense oak, willow, or other tree stands near open grassland meadows, farmlands, and emergent wetlands.	Moderate. Suitable foraging and nesting habitat in Project Area.
Northern harrier (*Circus cyaneus*)	CSC	Nests in freshwater and saltwater marshes and grasslands; forages in grasslands, agricultural fields, and marshes.	Moderate. Suitable foraging and nesting habitat in Project Area.
Short-eared owl (*Asio flammeus*)	CSC	Freshwater and saltwater marshes; open grasslands, prairies, and sand dunes. Nests on the ground in herbaceous cover or under shrubs	Low. Suitable nesting and foraging habitat is present within the Project Area, although species is uncommon.

Species Name	Status	Habitat	Potential for Occurrence Onsite
Golden eagle (*Aquila chrysaetos*)	CSC	Mountainous forests and open grasslands, found in many habitats during migration, nests on ledges or in tall trees.	Low. Suitable foraging habitat exists within the Project Area and limited nesting habitat, although species is uncommon.
Burrowing owl (*Athene cunicularia*)	CSC	Forages in open plains, grasslands and prairies; typically nests in abandoned small mammal burrows.	None. No suitable nesting (burrows) and limited foraging habitat is present within the Project Area. The species is not known from the area.
Mammals			
American badger (*Taxidea taxus*)	CSC	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats with friable soils. Needs sufficient food source (mostly burrowing rodents) and open, uncultivated ground.	None. No suitable habitat present. Only known occurrence in the vicinity is from 1948.
Hoary bat (*Lasiurus cinereus*)	Considered a Special Animal by CDFG	Prefers open habitats or habitat mosaics with access to trees for cover and open areas or habitat edges for feeding. Roosts in dense foliage of medium to large trees, feeds primarily on moths. Requires water.	Low. Foraging and roosting habitat present, however, the species has not been recorded in Pacifica.
Fringed myotis (*Myotis thysanodes*)	Considered a Special Animal by CDFG	Occurs in a wide variety of habitats. Optimal habitats are pinyon-juniper, valley foothill hardwoods, and hardwood-conifer. Uses caves, mines, building or crevices for maternity colonies and roosts.	None. No suitable habitat present.
Pallid bat (*Antrozous pallidus*)	CSC	Occurs in oak woodland habitat in central and northern California, among other habitat types. Roost sites include rock outcrops, mines, caves, tree hollows, buildings, and bridges.	None. Preferred habitat not on site.
San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*)	CSC	Forest habitats of moderate canopy & moderate to dense understory. May prefer chaparral & redwood habitats.	Low. Suitable habitat on site, but no nests were observed during site surveys.
Plants			
Franciscan onion (*Allium peninsulare* var. *franciscanum*)	CNPS 1B.2	Found in cismontane woodlands, valleys, and foothill grasslands on serpentine and clay soils of dry hillsides between 100-300 m.	None. No suitable habitat present in areas that would be disturbed for project activities.
Bent-flowered fiddleneck *(Amsinckia lunaris)*	CNPS 1B.2	Cismontane woodland, valley and foothill grassland	None. Species not found within areas that would be disturbed for project activities.

Species Name	Status	Habitat	Potential for Occurrence Onsite
Presidio manzanita (*Arctostaphylos hookeri* ssp. *ravenii*)	FE, SE, CNPS 1B.1	Chaparral and coastal prairie, typically on serpentine.	None. No manzanitas present in areas that would be disturbed for project activities.
San Bruno Mtn. Manzanita (*Arctostaphylos imbricate*)	SE, CNPS 1B.1	Coastal scrub and chaparral, known from five occurrences on San Bruno Mountain	None. Species is restricted to San Bruno Mountain.
Montara manzanita (*Arctostaphylos montaraensis*)	CNPS 1B.2	Found within chaparral and coastal scrub on slopes and ridges between 150-500 m.	None. No manzanitas present in areas that would be disturbed for project activities.
Kings mountain manzanita (*Archtostaphylos regismontana*)	CNPS 1B.2	Occurs within broadleaved upland forests, chaparral, and north coast coniferous forests on granitic or sandstone outcrops between 305-730 m.	None. No manzanitas present in areas that would be disturbed for project activities.
Pappose tarplant (*Centromadia parryi ssp. parryi*)	CNPS 1B.2	Can be found within coastal prairies, meadows and seeps, coastal salt marsh, and valley and foothill grasslands, generally on alkaline sites.	None. No suitable habitat present in areas that would be disturbed for project activities.
San Francisco Bay spineflower (*Chorizanthe cuspidata* var. *cuspidata*)	CNPS 1B.2	Found within coastal bluff scrub, coastal dunes, coastal prairie, and coastal scrub on terraces and slopes with sandy soils between 5-550 m.	None. No suitable habitat present in areas that would be disturbed for project activities.
Franciscan thistle (*Cirsium andrewsii*)	CNPS 1B.2	Occurs within coastal bluff scrub, broadleaved upland forest, and coastal scrub. Sometimes found on serpentine seeps.	None. Species not found within areas that would be disturbed for project activities.
Fountain thistle (*Cirsium fontinale* var. *fontinale*)	FE, CE, CPNS 1B.1	Valley and foothill grasslands, typicallly on serpentine soils.	None. No suitable habitat present in areas that would be disturbed for project activities.
Compact cobwebby thistle (*Cirsium occidentale* var. *compactum*)	CNPS 1B.2	Chaparral, coastal dunes, coastal scrub, coastal prairie. Known from fewer then twenty occurrences.	None. Species not found within areas that would be disturbed for project activities.
San Francisco collinisia (*Collinisia multicolor*)	CNPS 1B.2	Within close-cone coniferous forests and coastal scrub on decomposed shale (mudstone) mixed with humus at 30-250 m.	None. No suitable habitat present in areas that would be disturbed for project activities.
Western leatherwood (*Dirca occidentalis*)	CNPS 1B.2	Broadleafed upland forest, chaparral, closed-cone coniferous forest, cismontane woodland, north coast forest, riparian forest and woodland. On brushy slopes, mesic sites; mostly in mixed evergreen & foothill woodland communities. 30-550m.	None. Species not found within areas that would be disturbed for project activities.

Species Name	Status	Habitat	Potential for Occurrence Onsite
San Mateo wooly sunflower (*Eriophyllum latilobum*)	FE, SE, CNPS 1B.1	Cismontane woodland. Often on roadcuts; found on and off of serpentine.	None. Species not found within areas that would be disturbed for project activities.
Fragrant fritillary (*Fritillaria liliacea*)	CNPS 1B.2	Coastal scrub, valley and foothill grassland, coastal prairie. Often on serpentine; various soils reported though usually clay, in grassland.	None. Species not found within areas that would be disturbed for project activities.
San Francisco gumplant (*Grindelia hirsutula var. maritime*)	CNPS 1B.2	Coastal scrub, coastal bluff scrub and valley and foothill grasslands.	None. Species not found within areas that would be disturbed for project activities.
Diablo helianthella (*Helianthella castanea*)	CNPS 1B.2	Broadleaved upland forest, chaparral, cismontane woodland, coastal scrub, riparian woodland, valley & foothill grassland.	None. Species not found within areas that would be disturbed for project activities.
Kellogg's horkelia (*Horkelia cuneata ssp. sericea*)	CNPS 1B.1	Found on sandy soils & old stabilized dunes with open vegetation	None. No suitable habitat present in areas that would be disturbed for project activities.
Point Reyes horkelia (*Horkelia marinensis*)	CNPS 1B.2	Coastal dunes, coastal prairie, and coastal scrub.	None. Species not found within areas that would be disturbed for project activities.
Coast yellow leptosiphon (*Leptosiphon croceus*)	CNPS 1B.1	Coastal bluff scrub and coastal prairie.	None. No suitable habitat present in areas that would be disturbed for project activities.
Rose leptosiphon (*Leptosiphon rosaceus*)	CNPS 1B.1	Coastal bluff scrub.	None. No suitable habitat present in areas that would be disturbed for project activities.
San Francisco lessingia (*Lessingia germanorum*)	FE, SE, CNPS 1B.1	Associated with areas of sparse, low vegetative cover in older sand dunes	None. No suitable habitat present in areas that would be disturbed for project activities.
Crystal springs lessingia (*Lessingia arachnoidea*)	CNPS 1B.2	Coastal sage scrub, valley and foothill grasslands and cismontane woodlands. Found on grassy slopes on serpentine soils.	None. Species not found within areas that would be disturbed for project activities.
Indian Valley bush-mallow (*Malacothamnus aboriginum*)	CNPS 1B.2	Cismontane woodland and chaparral on granitic outcrops and sandy bare soil. Often found on disturbed soils.	None. No suitable habitat present in areas that would be disturbed for project activities.

Species Name	Status	Habitat	Potential for Occurrence Onsite
Arcuate bush-mallow (*Malacothamnus arcuatus*)	CNPS 1B.2	Chaparral on gravelly alluvium.	None. No suitable habitat present in areas that would be disturbed for project activities.
Davidson's bush-mallow (*Malacothamnus davidsonii*)	CNPS 1B.2	Coastal scrub, riparian woodland and chaparral. Usually associated with sandy washes.	None. Species not found within areas that would be disturbed for project activities.
Hall's bush mallow (*Malacothamnus hallii*)	CNPS 1B.2	Chaparral; some populations have been found on serpentine soils.	None. No suitable habitat present in areas that would be disturbed for project activities.
White-rayed pentachaeta (*Pentachaeta bellidiflora*)	FE, SE, CNPS 1B.1	Occurs within valley and foothill grasslands on open, dry, and rocky slopes. Often found on soils derived from serpentine bedrock.	None. Species not found within areas that would be disturbed for project activities.
Choris' popcorn-flower (*Plagiobothrys chorisianus* var. *chorisianus*)	CNPS 1B.2	Chaparral, coastal scrub, and coastal prairie.	None. Species not found within areas that would be disturbed for project activities.
Hickman's cinquefoil (*Potentilla hickmanii*)	FE, SE, CNPS 1B.1	Occurs within coastal bluff scrub, grassy openings in closed cone coniferous forest, meadows, seeps, marshes and swamps.	None. No suitable habitat present in areas that would be disturbed for project activities.
San Francisco campion (*Silene verecunda ssp. verecunda*)	CNPS 1B.2	Coastal scrub, valley and foothill grasslands, coastal bluff scrub, chaparral and coastal prairie.	None. Species not found within areas that would be disturbed for project activities.
Coastal triquetrella (*Triquetrella californica*)	CNPS 1B.2	Coastal bluff scrub, coastal scrub.	None. Species not found within areas that would be disturbed for project activities.
San Francisco's owl's clover (*Triphysaria floribunda*)	CNPS 1B.2	Coastal prairie and valley and foothill grasslands on serpentine and non-serpentine soils.	None. Species not found within areas that would be disturbed for project activities.
Communities			
Northern coastal salt marsh	N/A	Occurs along the intertidal shores of bays and estuaries. Few, hydrophytic plants dominate. A highly productive community.	None. Habitat does not occur within areas that would be disturbed for project activities
Serpentine bunch grass	N/A	Vegetation dominated by native bunch grasses and occurring on serpentine soils.	None. Habitat does not occur within areas that would be disturbed for project activities

Species Name	Status	Habitat	Potential for Occurrence Onsite
Northern maritime chaparral	N/A	Maritime chaparral contains plants adapted to areas with cool, foggy summers. Generally found on nutrient poor soils and occurs on windward uplands and coastal lowlands. *Arctostaphylos* and *Ceanothus* species characterize the habitat.	None. Habitat does not occur within areas that would be disturbed for project activities
Valley needlegrass grassland	N/A	Dominated by the perennial, tussock forming purple needlegrass (*Nasella pulchra*). Usually on fine-textured (often clay) soils; moist or even waterlogged in winter, but very dry in summer	None. Habitat does not occur within areas that would be disturbed for project activities

Notes: FE: Federal endangered; FT: Federal threatened; SE: State endangered; ST: State threatened; CSC: California species of special concern; CFP: California Fully Protected;
CNPS - California Native Plant Society

List 1A: plants presumed extinct in California
List 1B: plants rare, threatened, or endangered in California and elsewhere
List 2: Plants rare, threatened, or endangered in California, but more common elsewhere
List 3: Plants about which we need more information - a review list
List 4: Plants of limited distribution - a watch list
Threat Ranks:
0.1 - seriously threatened in California (high degree/immediacy of threat)
0.2 - fairly threatened in California (moderate degree/immediacy of threat)
0.3 - not very threatened in California (low degree/immediacy of threats or no current threats known

NCCWD Pacifica Water Recycling Project
Environmental Assessment

APPENDIX B
Geotechnical Exploration CCWRP Station

GEOTECHNICAL EXPLORATION

CALERA CREEK WATER RECYLING PUMP STATION

PACIFICA, CALIFORNIA

SUBMITTED

TO

KENNEDY JENKS CONSULTANTS

PALO ALTO, CALIFORNIA

PREPARED

BY

ENGEO INCORPORATED

PROJECT NO. 7443.1.001.01

NOVEMBER 6, 2006

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GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES
CONSTRUCTION SERVICES

Project No.
7443.1.001.01

November 3, 2006

Mr. John Rayner
Kennedy/Jenks Consultants
2191 East Bayshore Road, Suite 200
Palo Alto, CA 94303

Subject: Pump Station
Calera Creek Water Recycled Plant
NCCWD Recycled Water Project
Pacifica, California

GEOTECHNICAL EXPLORATION

Dear Mr. Rayner:

With your authorization, we have conducted a design-level geotechnical exploration for the Calera Creek Water Recycling Plant pump stations located in Pacifica, California. The accompanying report presents the results of our site exploration and geotechnical recommendations for design of the proposed pump station. Based on our study, it is our opinion that the currently proposed project is feasible from a geotechnical standpoint provided the recommendations included in this report are followed.

We are pleased to have been of service to you on this project and look forward to consulting further with you and your design team.

Very truly yours,

ENGEO INCORPORATED

Stefanos Papadopulos, PE
sap/smc:gex

REGISTERED PROFESSIONAL ENGINEER
STEFANOS PAPADOPULOS
No. 69398
Exp. 6/30/08
CIVIL
STATE OF CALIFORNIA

Reviewed by:

R. William Rudolph, GE

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November 3, 2006

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INTRODUCTION

Purpose and Scope

The purpose of this report is to provide geotechnical engineering recommendations to assist you and your design team in developing plans and specifications for construction of the proposed pump station at the Calera Creek Water Recycling Plant site.

The scope of our services included the following:

1. A review of existing geotechnical data.
2. Exploratory drilling and sampling of one test boring.
3. Laboratory testing of selected subsurface materials.
4. Analysis of the geological and geotechnical data.
5. Preparation of this report summarizing our findings and pump station design recommendations.

This report was prepared for the exclusive use of Kennedy/Jenks Consultants and the North Coast County Water District (NCCWD). In the event that any changes are made in the character, design or layout of the project, the conclusions and recommendations contained in this report must be reviewed by ENGEO Incorporated to determine whether modifications to the report are necessary. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without the express written consent of ENGEO Incorporated.

Site Location and Project Description

The City of Pacifica's Calera Creek Water Recycling Plant (CCWRP) is located on hillside south of Mori Point Ridge, west of Highway 1 and is accessed by Highway 1 and Rio Del Mar Avenue. The Recycled Water Pump Station will be located south of the Tertiary Filter and UV Disinfection Structure on the CCWRP site. The pump station is expected to have two pumps, a 10-foot-diameter wet well, and a 30-inch diameter manway. It also will have facilities to feed a disinfectant, hypochloride solution into the recycled water. A 14-inch-diameter pipeline will connect the existing clear well to the pump station's wet well. An 8-inch-diameter pipeline will connect the wet well to a meter and static mixer vault and a sampling vault and a 12-inch-diameter pipeline will connect the sampling vault to the new recycled water storage tank.

The Pump Station structure will have maximum plan dimensions of 17.5 by 13 feet. Grade elevation at the pump station will be approximately +79 feet, with the main flow channels of both pumps situated at about +82.5 feet. The deepest portion of the pump station will be the wet well with bottom elevation at about + 52 feet. The wet well structure will likely be supported on an 18- to 24-inch-thick concrete slab.

An electrical building structure will be constructed 5 feet east of the pump station building. This structure will have maximum plan dimensions 14 by 7.5 feet. A chemical building structure will be constructed 5 feet east of the electrical building. This structure will have maximum dimensions 7.5 y 12 feet. All three building structures will be on a concrete slab-on-grade 54.5 feet long by 16.75 wide.

GEOLOGY AND SEISMICITY

Regional Geology

Based on the geologic map by Brabb and others (1998), the geologic materials underlying the CCWRP site are mapped artificial fill materials (af) and colluvium (Qcl) over Franciscan greenstone (fs).

It appears that any colluvium (Qcl) beneath the pump station site was removed during grading at the CCWRP and artificial fill (af) was placed on the top of the underlying greenstone. The artificial fill is composed of an assortment of soils including silty clays, sandy clays and some sands and gravels. The thickness of the artificial fill beneath the pump station site is approximately 35 feet. The fill is compacted and it is stiff to hard. The Franciscan greenstone (fs) beneath the fill is dark-green to red altered basaltic rocks, including flows, pillow lavas, breccias, tuff breccias, and tuffs.

Faulting and Seismicity

The site is located in a region that contains numerous active earthquake faults. The closest active fault is the San Andreas Fault located about 3 Kilometers northeast of the site. Seal Cove/San Gregorio fault is located 5 Kilometers northwest from the site and the Hayward fault is located 33 kilometers east from the site. Numerous small earthquakes occur every year in the San Francisco Bay Region, and larger earthquakes have been recorded and can be expected to occur in the future. The site will likely be subjected to strong ground shaking because of its proximity to several active faults.

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REGIONAL FAULTS AND SEISMICITY

Fault Segment	Approximate Distance from site (km)	Direction from site	Maximum Magnitude
San Andreas (1906 Rupture)	3	Southwest	7.9
San Andreas (Peninsula)	3	Southwest	7.2
San Gregorio (North)	5	West	4.3
San Andreas (North Coast South)	24	West	7.5
Monte Vista	29	South	6.8
Monte Vista	29	South	6.8
Hayward (Total)	33	Northeast	7.2
Hayward (North)	33	Northeast	6.3
Hayward (South)	34	East	3.6
Calaveras (North)	47	East	7.0
Rodgers Creek	54	North	7.1
Concord	54	Northeast	6.5

GEOTECHNICAL EXPLORATION

Exploratory Borings

One exploratory boring was drilled on October 12, 2006, at the proposed pump station location. The test boring was drilled using a truck-mounted drill rig equipped with a 6-inch-diameter continuous flight solid stem auger. An ENGEO Geologist logged the borings in the field in accordance with the Unified Soil Classification System. Soil samples were recovered using either a 2½-inch inside diameter (I.D.) California-type split-spoon sampler fitted with 6-inch-long brass liners or typical SPT sampler with no liner. The samplers were advanced by a 140-pound safety hammer with a 30-inch drop, employing a rope and cathead system. The penetration of the sampler into the native materials was field recorded as the number of blows needed to drive the sampler 18 inches in 6-inch increments. Blow count results on the boring logs are recorded as the number of blows required for the last one foot of penetration. When driving refusal was encountered, penetration was recorded as the number of blows per inch of penetration. The field logs were used to develop the attached boring logs.

The boreholes were backfilled with grout on the day of drilling in accordance with regulations from San Mateo Environmental Health Division. The county inspector was notified of the drilling and the intention to grout, but did not visit the site.

Laboratory Testing

Following drilling, we reexamined the samples in our laboratory to confirm field classifications. Representative samples recovered from the boring were tested for the following physical characteristics:

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Characteristic	Test Method	Location of Results Within this Report
Natural Unit Weight	ASTM D-2216	Boring Logs
Natural Moisture Content	ASTM D-2216	Boring Logs
Atterberg Limits	ASTM D-4318	Appendix A
Triaxial (UU)	ASTM D-4767	Appendix A

Laboratory test results are included on the boring logs and also on Appendix A, as noted above.

Subsurface Stratigraphy

Subsurface exploratory work for pump station study consisted of obtaining samples from the two major materials on site; artificial fill and Franciscan greenstone. Exploratory boring 1-B4 was advanced through approximately 35 feet of existing engineered fill and it was terminated into Franciscan greenstone where it reached refusal.

The proposed pump station is located approximately 4 feet away from the existing Tertiary Filter structure. The ground surface at the pump station site is paved with 3 inches of asphaltic concrete (AC) placed on the top of 6 inches of aggregate base (AB). Stiff silty clay fill was encountered below the AB to a depth of about 5 feet, underlain by medium dense silty sand fill extending to a depth of about 10 feet below ground surface. Stiff to very stiff silty clay fill with some sand and gravel extended from 10 feet to about 35 feet below ground surface underlain by Franciscan greenstone.

Groundwater Conditions

Groundwater was encountered during drilling at a depth of 29.5 feet below grade, corresponding to an elevation of approximately +49.5 feet. After several hours, groundwater equalized at a depth of

16 feet below grade, corresponding to an elevation of approximately +63 feet. Fluctuations in groundwater levels may occur seasonally and over longer periods of time due to variations in rainfall, temperature, irrigation and other factors not evident at the time the measurements were made.

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DISCUSSION

The major geotechnical issues of concern associated with the proposed structures include:

- Seismic hazards
- Settlement
- Adequate foundation support
- Groundwater
- Excavation and shoring
- Soil corrosivity

Seismic Hazards

Potential seismic hazards resulting from a nearby moderate to major earthquake may include primary ground rupture, ground shaking, lurching, liquefaction, dynamic densification, lateral spreading, and earthquake-induced landsliding. These hazards are discussed below. Risks from seiches, tsunamis and inundation due to embankment failure are currently considered low at the pump station site.

Ground Rupture. No known seismogenic faults have been mapped at the locations of the proposed pump station; therefore, the potential for ground rupture is considered low.

Ground Shaking. An earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site. The degree of shaking is dependent on the magnitude of the event, the distance to its zone of rupture, and local geologic conditions. To mitigate the ground shaking effects, all structures should be designed using sound engineering judgment and the latest Uniform Building Code (UBC) requirements as a minimum. In accordance with the 1997 UBC, the site is located within Seismic Zone 4, with a seismic zone factor Z of 0.4, as given in Figure 16-2 and Table 16-I in the UBC. Based on site conditions, the soil profile at the pump station site can be classified as SD, as defined in Table 16-J. According to Tables 16-S and 16-T, near source factors, Na and Nv, are based on the San Andreas fault being a seismic source type A, approximately 3 km away. The UBC parameters for pump station sites are presented in the following table:

1997 UNIFORM BUILDING CODE - Chapter 16

ITEM	PUMP STATION DESIGN VALUE	SOURCE
Seismic Zone	4	Figure 16-2
Seismic Zone Factor	0.40	Table 16-I
Soil Profile Type	S_D	Table 16-J
Seismic Source Type	A	Table 16-U
Near Source Factor, Na	1.4	Table 16-S
Near Source Factor, Nv	1.9	Table 16-T
Seismic Coefficient, Ca	0.44Na	Table 16-Q
Seismic Coefficient, Cv	0.64Nv	Table 16-R

Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead and live loads. The prescribed lateral forces are generally considered to be substantially smaller than the actual peak forces that would be associated with a major earthquake. Consequently, structures should be able to: (1) resist minor earthquakes without damage, (2) resist moderate earthquakes without structural damage but with some nonstructural damage, and (3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake.

Liquefaction. Liquefaction is a phenomenon in which saturated (submerged), cohesionless soil experiences a temporary loss of strength because of the buildup of excess pore water pressure, especially during cyclic loadings such as those induced by earthquakes. Soil most susceptible to liquefaction is loose, clean, saturated, uniformly graded fine-grained sand. Flow failure, lateral spreading, differential settlement, loss of bearing, ground fissures, and sand boils are evidence of excess pore pressure generation and liquefaction.

The site is at the margins of an area designated as potentially liquefiable (AGAP Liquefaction Susceptibility Map, Source: USGS Open file report 00-44, Knudsen & Others, 2000). In the recent boring drilled at the location of the proposed pump station, the existing fill is predominantly sandy clay and silty clay and is stiff below the groundwater table. It is our opinion, that given the existing fill consists of clayey material the potential for liquefaction of the on-site material is low.

Lateral Spreading. Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces. Because the site is relatively flat and is not near an open slope, we conclude the potential for lateral spreading is low.

Seismic Densification. Seismic densification can occur during strong ground shaking in loose, clean granular deposits above the water table, resulting in ground surface settlement. The sand layer encountered above the groundwater table at the pump station location is medium dense and mixed with silt. Therefore, we estimate that densification settlement due to earthquake will be insignificant.

Foundations and Structure Settlement

At-Grade Structures. Preliminary construction plans show the footprint of pump house, electrical and chemical building structures on concrete slab-on-grade 54.5 feet long by 16.75 wide. The anticipated loads on the at-grade concrete pad provided by Kennedy/Jenks Consultants are relatively light and they are not expected to exceed 300 psf for dead plus live loads. The factors influencing the design of the at-grade building foundation include: differential settlement between the building and the adjacent below grade structures and surrounding ground surface. The uniformity and strength of the fill

Significant excavation will be required to construct the below grade wet well and pipeline. Differential settlement under the concrete slab may result primarily from compression of newly placed fill with differential thickness. Differential fill thickness will depend on the excavation and shoring method selected for the construction of the wet well and associated 14-inch-diameter underground water line. An open pit excavation with temporary cut slopes will create differential fill thickness and therefore potential for differential settlement under the slab-on-grade. To reduce that potential we recommend the slab-on-grade be supported on a small number of drilled piers, minimum 24-inch diameter extending 30 feet below ground surface or into bedrock which ever comes first.

A shored excavation such as soldier beam and lagging, sheet pile, or caisson excavation will require placement of new fill only in a limited area. To reduce the potential for differential settlement we recommend the section of the concrete slab outside the excavation footprint may be supported on compacted subgrade while the section of the concrete slab within and up to the limits of the excavation foot print be supported by the wet well. Alternatively, a section of the slab may be supported by the wet well and the remainder by a limited number of drilled piers, minimum 24-inch diameter extending 30 feet below ground surface or bedrock which ever comes first.

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Below Grade Pump Station. The below grade pump station will extend into the existing engineered fill, and the bottom of the wet well will be more than 17 feet below the design groundwater level. Groundwater level is assumed at elevation +69.0. Accordingly, the wet well will need to be designed to resist hydrostatic uplift. We computed the factor of safety against hydrostatic uplift for the wet well using a design groundwater elevation of 69 feet and the dimensions and elevations shown on the 50 percent submittal plans. Information provided by Kennedy/Jenks Consultants indicates the wet well base slab measuring a minimum 13 feet square in plan centered on the wet well and a dead load for the wet well base, wet well and wet well top slab 115.5 kips in dry conditions. The hydrostatic uplift force acting at the bottom of the wet well at elevation +52 feet is estimated at 84 kips. If structure dimensions, structure elevations, or fill elevations are modified, we should reevaluate our analysis. The factor of safety against uplift is1.4 for a design water level of elevation + 69 feet and structure weight of 115.5 kips. The factor of safety will be greater than 1.5 if the weight of the soil over the base slab lip is added to the weight of the structure.

Groundwater

The groundwater level during drilling at the pump station was encountered at a depth that corresponds to elevations +63 feet. Due to the potential for variations in groundwater level because of seasonal fluctuations, we conclude a design groundwater level that corresponds to elevation +69 feet should be used in design.

The excavation for the below grade pump station structure will extend below the design groundwater table. Groundwater will need to be removed from the excavation during construction. The method of dewatering will depend to an extent on the method of shoring. Groundwater seepage through the existing fill should be moderately slow, though flow through zones of sandy fill could be high. A tight shoring system should be used. Accordingly, the groundwater flow should be relatively low and groundwater removal can be achieved using sumps and pumps.

Excavation and Shoring

The proposed pump station site is in existing fill that was placed during the construction of the CCWRP. The fill should be able to be excavated with an excavator. Construction of the wet well and associated 14-inch recycled water line will require a shored excavation or an open pit excavation with temporary cut slopes.

An open pit excavation 30 feet deep will require dewatering and sufficient space to construct temporary cut slopes and mid-slope bench if needed. The proposed gradient for the temporary cut slopes should be reviewed by the geotechnical engineered prior to commencement of excavation work.

Shored excavation methods such as soldier beam and lagging, braced sheetpile wall, large diameter caisson, secant pile shoring or other type of watertight shoring system should provide satisfactory temporary support and limit seepage during construction of the wet well. The selected shoring scheme should be reviewed by the geotechnical engineer.

Based on our review of the CCWRP construction plans provided by Kennedy/Jenks Consultants, the wet well excavation will undermine the foundation of the tertiary filters. The bottom of the excavation will extend 2.5 to 4 feet below the adjacent tertiary filter slab. The selected shoring scheme should be designed to provide adequate support to the adjacent footing during construction of the wet well. In addition, as a minimum the area between the wet well wall and the tertiary filter should be backfilled with lean concrete from the bottom of the excavation to at least 1 foot above the bottom of the adjacent footing.

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Excavation for construction of the14-inch recycled water pipeline section parallel with the tertiary filter system will undermine the footing of the tertiary filter clearwell stairway structure. The bottom of the excavation will extend up to 7 feet below the adjacent footing and the selected shoring scheme should provide adequate support to the adjacent structure during construction of the pipeline. In addition, the pipeline section transverse to the clearwell will run under the stairway structure before entering the clearwell. Support of the stairway structure should be maintained during excavation.

Corrosion Potential

An evaluation of possible corrosion impacts to site improvements has been conducted. Samples collected at a depth of 5 feet and 25 feet were sent to an outside lab for chemical testing. Based upon resistivity measurements, the sample at 25 feet depth was classified as "corrosive" and the sample at 5 feet depth was classified as "moderately corrosive". Sulfate ion concentration for both samples was determined to be insufficient to damage reinforced concrete structures and cement mortar-coated steel at sample locations. A corrosivity evaluation and test results are included in Appendix B.

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RECOMMENDATIONS

From a geotechnical standpoint, we conclude the site can be developed as planned, provided the recommendations presented in this section of the report are incorporated into the design and contract documents. Criteria for foundation design, together with recommendations fill placement, and other topics, are presented in this section of the report.

Foundations

We have noted in the discussion for foundation and structure settlement, the foundation for the at-grade structures will be either a concrete slab supported on a limited number of piers or a slab-on-grade depending on the excavation scheme selected for the construction of the wet well and associated underground water line. The wet well can be supported on a concrete slab.

For slab-on-grade a maximum allowable bearing pressure of 1,000 pounds per square foot (psf) for dead-plus-live loads may be used. This value may be increased by one-third for total loads including wind and seismic. The slab should be designed by the Structural Engineer for the anticipated loading conditions and should be a minimum of 5 inches thick with proper reinforcement and joints for control of cracking.

For pier supported slab, piers should be inter-connected by the slab, have a minimum 24-inch diameter and depth not less than 30 feet. The pier load capacity may be determined using a side friction of 500 psf, neglecting the upper 2 feet of pier embedment. The allowable pier uplift capacity may be determined using a side friction of 350 psf plus the weight of the pier. The pier spacing should be determined from the load-bearing capacity of the piers; in no case should be less than three pier diameters on center.

For the wet well bottom mat foundation a maximum allowable bearing pressure of 2,000 pounds per square foot (psf) for dead-plus-live loads may be used. This value may be increased by one-third for total loads including wind and seismic. The mat foundation should be designed to resist the hydrostatic uplift pressure resulting from a design groundwater table at Elevation 69 feet. Resistance to lateral loads should be computed using a base friction of 0.35 acting between the bottom of the mat and the subgrade.

Prior to construction, the subgrade should be prepared as described below in the subgrade preparation section. The finished subgrade should be smooth and unyielding. Where vapor migration through the slab would be undesirable, slabs should be underlain by at least 6 inches of clean gravel or crushed rock to act as a capillary break. The capillary break should be covered with a vapor retarder, such as one layer of 20-mil-thick plastic sheeting two layers of 10-mill-thick plastic sheeting. The structural Engineer should be consulted on the appropriateness of providing two inches of sand over the vapor barrier.

Wet Well Walls

We recommend that the wet well wall be designed to resist lateral pressures imposed by the adjacent soil, vehicles, and the adjacent building structures. Accordingly, walls should be designed for the pressures presented below:

LATERAL EARTH PRESSURES

	Restrained Walls	Seismic Condition1
Fill above the water table2	60 pcf	40 pcf + 15H psf
Fill below the water table	95 pcf	85 pcf + 15H psf

Where traffic is expected within 10 feet of the walls, a surcharge of 100 psf should be added to the top 10 feet of wall. Where other building structures will abut the below grade pump station structure, a surcharge equal to one half the buildings mat bearing pressure should be added to the wall pressure distribution.

Earthwork

Demolition. The proposed pump station site is currently paved. All pavement should be removed under the footprint of the 54.5 feet long by 16.75 wide slab-on-grade, and exposed subgrade should be cleaned to firm undisturbed soil as determined by the Geotechnical Engineer's representative.

Subgrade Preparation. All areas to receive fill, slabs-on-grade, or pavements should be scarified to a depth of at least 12 inches (30 centimeters), moisture conditioned, and compacted to the requirements for engineered fill presented below. The finished subgrade should be firm and non-yielding under the weight of compaction equipment.

Fill Materials. The site soils and bedrock containing less than 3 percent organics are suitable for use as engineered fill. Import materials, if any are needed, must bee free of organics, have a PI less than 12 and the larger particle size should be less than 6 inches in diameter. The Geotechnical Engineer should be informed if any importation of soil is contemplated. A sample of the proposed import material should be submitted to the Geotechnical Engineer for evaluation prior to delivery at the site.

Placement of Fill. The following compaction control requirements should be generally applied to engineered fills:

Description	Minimum Relative Compaction (%)	Minimum Moisture Content (% over optimum)
Within the upper 5 ft	90	+2
Greater than 5 ft	95	0
Aggregate Baserock	95	0

Maximum dry densities and moisture contents should be determined in accordance with ASTM D-1557, latest edition. Plasticity Index determinations should be made as a part of grading control. All fills should be placed in lifts not exceeding 8 inches (20 centimeters) or the depth of penetration of the compaction equipment used, whichever is less.

Utilities

For shallow utilities, it is recommended that all utility trench backfill be done under the observation of a Geotechnical Engineer. Pipe zone backfill (i.e. material beneath and immediately surrounding the pipe) may consist of a well-graded import or native material less than ¾ inch (2 centimeters) in maximum dimension. Trench zone backfill (i.e. material placed between the pipe zone backfill and the ground surface) may consist of native soil compacted in accordance with recommendations for engineered fill.

Where import material is used for pipe zone backfill, we recommend that it consist of fine- to medium-grained sand or a well-graded mixture of sand and gravel and that this material not be used within 2 feet of finish grades. In general, uniformly graded gravel should not be used for pipe or trench zone backfill due to the potential for migration of (1) soil into the relatively large void spaces present in this type of material; and (2) water along trenches backfilled with this type of material. All utility trenches entering buildings and paved areas must be provided with an impervious seal consisting of native materials or concrete where the trenches pass under structure perimeters or curb lines. The impervious plug should extend at least 3 feet (1 meter) to either side of the crossing. This is to prevent surface water percolation into the sands under foundations and pavements where such water would remain trapped in a perched condition, allowing clays to develop their full expansion potential.

Utility trenches should not be located upslope of any foundation area unless the placement, depth, and backfill material to be used are reviewed by the Geotechnical Engineer. Care should be exercised where utility trenches are located beside foundation areas. Utility trenches constructed parallel to foundations should be located entirely above a plane extending down from the lower edge of the footing at an angle of 45 degrees. Utility companies and Landscape Architects should be made aware of this information.

Utility trenches in areas to be paved should be backfilled to the specifications provided in this report for engineered fill and in accordance with San Mateo County requirements; however, compaction of trench backfill by jetting shall not be allowed at this site.

Shoring and Excavation

All excavations including utility trench sidewalls should be properly shored or sloped back to a stable and safe condition. It is the responsibility of the Contractor to provide such stable, safe trench and construction slope conditions and to follow OSHA safety requirements. Excavation procedures may be very dangerous. It is the responsibility of the Contractor to provide a trained "competent person" as defined by OSHA to supervise all excavation operations; ensure that all personnel are working in safe conditions; and have thorough knowledge of OSHA excavation safety requirements. The

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Contractor should provide a copy of the geotechnical report to all subcontractors performing excavations at the site.

Plan Review and Construction Observation Service

It is important to the success of this project that the recommendations contained in this report be carefully implemented in the field. ENGEO should be retained to review the project plans and specifications to confirm that they meet the intent of the recommendations contained in this report.

We recommend that ENGEO be retained to provide soil engineering services during the excavation, shoring, backfilling and foundation installation phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from that anticipated prior to the start of construction.

At the completion of the earthwork and foundation construction aspects of the work, we will provide documentation of construction activities observed by ENGEO Incorporated along with a statement regarding the adequacy of the work observed.

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LIMITATIONS AND UNIFORMITY OF CONDITIONS

The conclusions and recommendations contained in this report are solely professional opinions. The professional staff of ENGEO Incorporated strives to perform its services in a proper and professional manner with reasonable care and competence but is not infallible. We are unable to eliminate all geotechnical risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our work.

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LIST OF FIGURES

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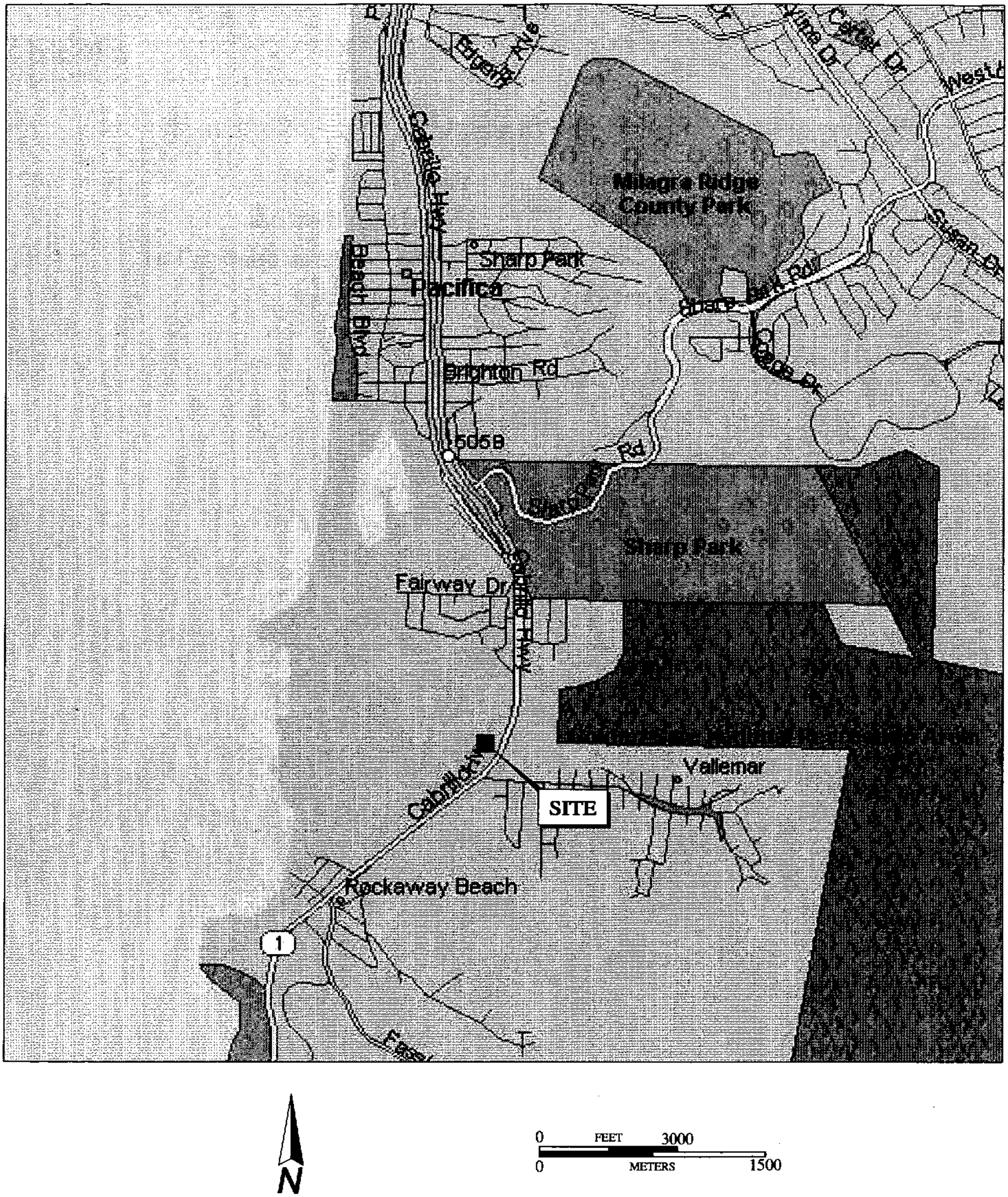

BASE MAP SOURCE: MS STREETS AND TRIPS

ENGEO INCORPORATED EXCELLENT SERVICE SINCE 1971	VICINITY MAP CCWRP PUMP STATION PACIFICA, CALIFORNIA	PROJECT NO.: 7443.1.001.01 DATE: NOVEMBER 2006 DRAWN BY: PC CHECKED BY: JW	FIGURE NO. 1

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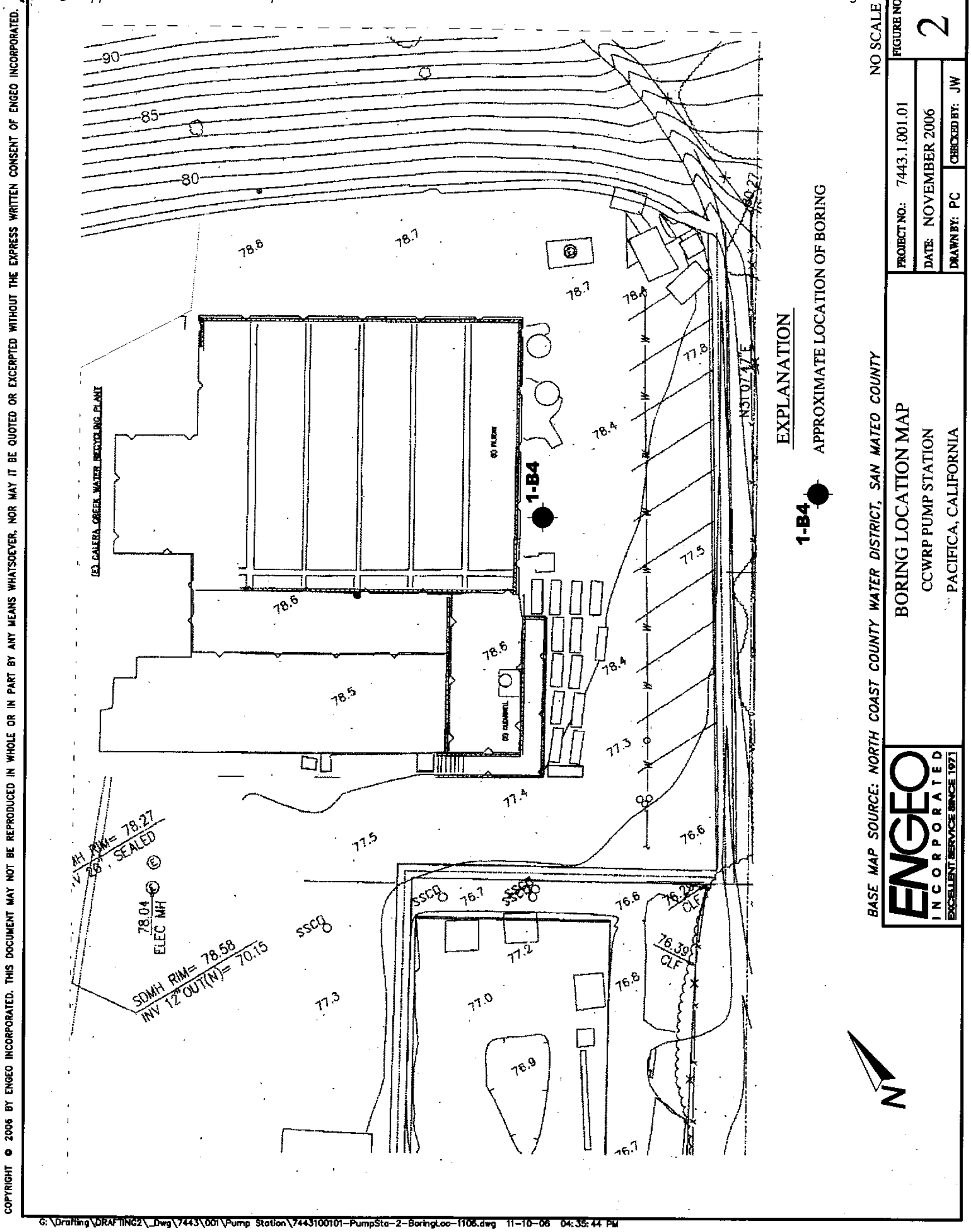
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CCWRP PUMP STATION
PACIFICA, CALIFORNIA
PROJECT NO: 7443.1.001.01
DATE: NOVEMBER 2006
DRAWN BY: PC
CHECKED BY: JW
FIGURE NO.
2
NO SCALE
EXPLANATION
1-B4 APPROXIMATE LOCATION OF BORING
BASE MAP SOURCE: NORTH COAST COUNTY WATER DISTRICT, SAN MATEO COUNTY
ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971
(E) CALERA CREEK WATER RECYCLING PLANT
1-B4
SDMH RIM= 78.58
INV 12" OUT(N)= 70.15
78.04
ELEC MH
SSCO
N
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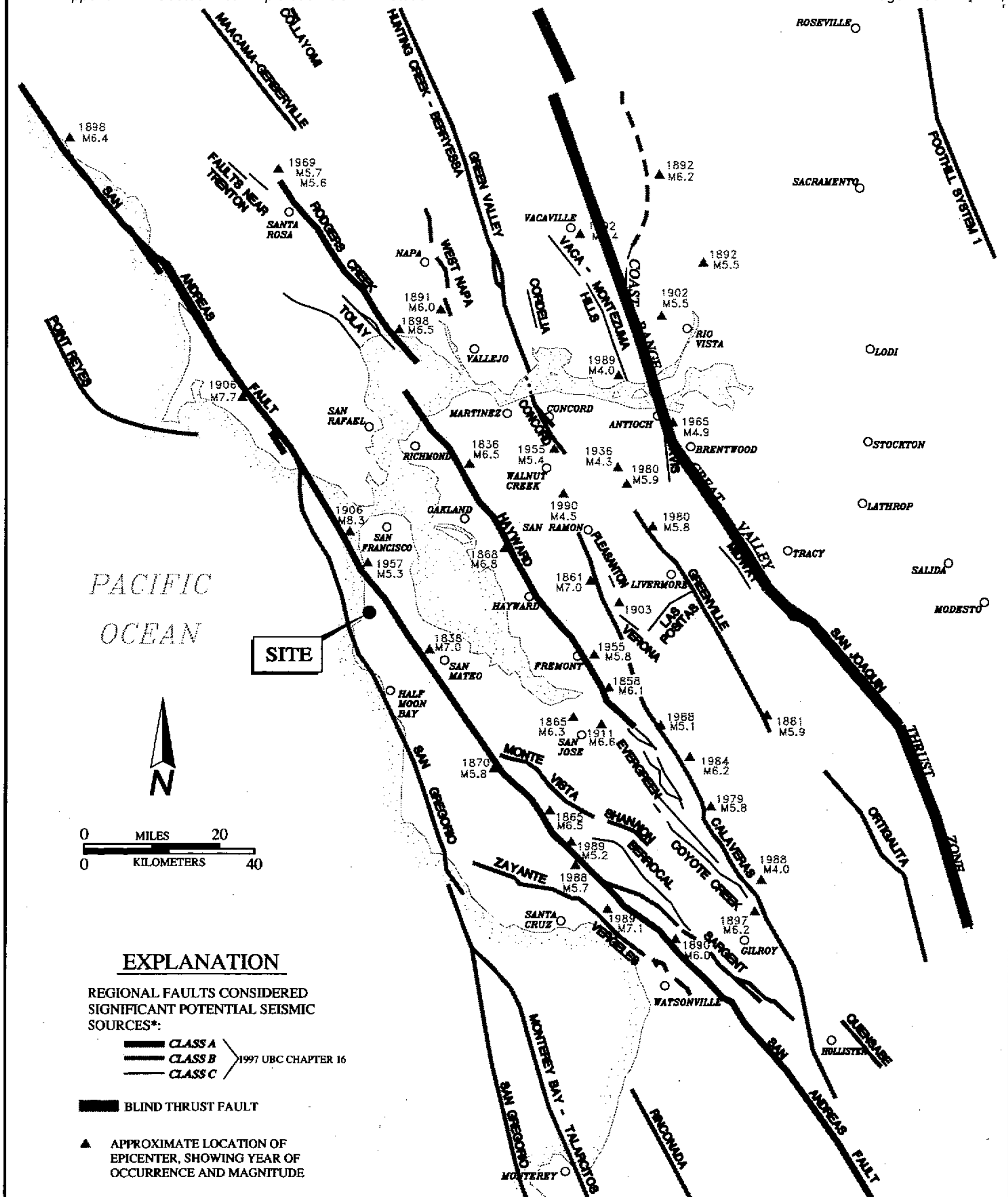

*BASED ON USGS OPEN FILE 96-706

ENGEO INCORPORATED EXCELLENT SERVICE SINCE 1971	REGIONAL FAULTING AND SEISMICITY CCWRP PUMP STATION PACIFICA, CALIFORNIA	PROJECT NO.: 7443.1.001.01 DATE: NOVEMBER 2006 DRAWN BY: PC CHECKED BY: JW	FIGURE NO. 3

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